

Facts  
about

# MONTANA'S WATER

## PRECIPITATION

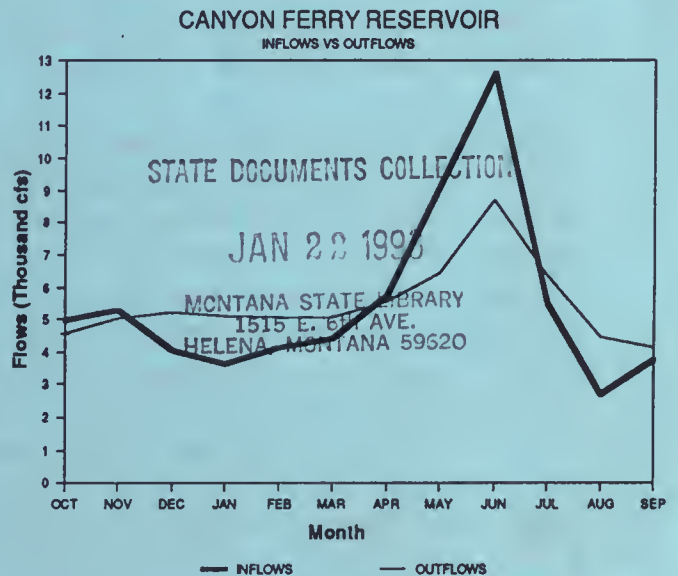
Some call Montana "water rich and water poor." The high mountain regions of western Montana near Glacier National Park receive between 80 and 120 inches of precipitation (both rainfall and snowfall) each year, but some parts of Montana receive only 6 to 14 inches per year. Most of eastern Montana is considered "semi-arid." One of the driest places in Montana is near Belfry, Montana, in the Clarks Fork of the Yellowstone basin. Here, annual precipitation is less than 8 inches, and the area is classified as "arid" or a desert. So are three other areas in Montana—the Helena Valley, the Whitehall-Twin Bridges Valley, and the lower Red Rock River drainage.

## RUNOFF PATTERNS

Even though Montana is water-poor in some areas, a lot of water originates in Montana's mountains. Mountain "runoff" and groundwater fill Montana's rivers and lakes. The high mountains store water as snowpack through the fall, winter, and early spring and release it as the snow melts in late spring and early summer. Flooding may occur, usually in May or June. After the snow is gone, flows in many rivers drop to low levels through late summer, fall, and winter. Some rivers and streams may even go dry. Flows typically don't increase much again until the snow begins to melt in late spring.

People have altered this natural pattern of flow on many streams. For instance, dams trap high flows in the spring and slowly release water in the summer and fall. This can decrease flows downstream of a dam in the spring, but increase them during other times of the year. People also remove or "divert" water from streams for crop irrigation or other uses. Diversions cause water levels to be lower than they would be otherwise.

In the figure below, notice the difference in the flow of the Missouri River upstream and downstream of Canyon Ferry Reservoir. The figure illustrates the effects of snowmelt on streamflow "inflow" and changes in streamflow "outflow" caused by a reservoir. The reservoir stores high spring runoff and releases the water during low flow periods.



"Hydrology" is the science dealing with water—its distribution, properties, and circulation. Hydrologists are concerned with all forms of water—on the land surface, in the soil, underground, and even in the atmosphere.

## RIVERS

Hydrologists tell us that over 44 million acre-feet of water leaves Montana each year. (One "acre-foot" is enough water to cover one acre of land to the depth of one foot and is equivalent to 325,851 gallons.) The largest rivers in Montana are the Clark Fork (15.6 million acre-feet), followed by the Kootenai (10.1 million), the Yellowstone (9.4 million), and the Missouri

(7.5 million). Most of the water (65 percent, or 28.5 million acre-feet) that leaves our state each year also originates here. The rest flows into Montana from Wyoming (the Clarks Fork, Bighorn, Tongue, and Powder rivers), Yellowstone Park (the Madison, Gallatin, and Yellowstone rivers), and Canada (the Kootenai, Milk, and Poplar rivers).

Montana is the headwaters of the Missouri, Columbia, and Saskatchewan river basins. Water falling on Triple Divide Peak in Glacier National Park ends up in three different drainages and oceans. Water flows north (into the St. Mary River and finally Hudson Bay and the Arctic Ocean); it flows east and south (into the Missouri and Mississippi rivers and finally the Gulf of Mexico and the Atlantic Ocean); and it flows west (into the Columbia River and finally the Pacific Ocean).

Some other interesting facts about Montana's rivers follow. The Yellowstone River, called "Elk River" by the Native Americans, is the longest free-flowing river in the lower 48 states. The Milk River, named for its milky color, originates in Montana, enters Alberta, Canada, and returns to Montana. It occupies portions of the ancient Missouri River channel and valley that were pushed southward thousands of years ago by large glaciers coming from Canada. The Big Hole River, which is the only river in Montana that travels both south and north, is home to most of the last stream-dwelling "arctic grayling"—a rare fish species. The U.S. Congress has designated the North Fork, South Fork, and Middle Fork of the Flathead River and a stretch of the Missouri River downstream of Fort Benton as "Wild and Scenic" to protect their natural beauty.

## LAKES AND RESERVOIRS

Montana has over 20,000 lakes and reservoirs. The largest freshwater lake (in surface area) west of the Mississippi River is Flathead Lake. One of Montana's newest lakes, Quake Lake, was created naturally by a catastrophic earthquake that dammed up the Madison River in 1959.

A "reservoir" is a lake created by a man-made dam. Fort Peck, the largest reservoir in the state, is located on the

Missouri River near Glasgow. This reservoir can store over 19 million acre-feet (or 6.321 trillion gallons) of water, and its shoreline is longer than the coastline of the state of California. Yellowtail Dam on the Bighorn River has created the biggest reservoir in the Yellowstone River basin, backing water into the state of Wyoming. Hungry Horse Reservoir on the South Fork of the Flathead River and Lake Koocanusa on the Kootenai River are large storage projects in the headwaters of the Columbia River. Lake Koocanusa derived its name from the first three letters of the name of the river—*Kootenai*; the first three letters of the word *Canada*, since it backs water into British Columbia; and the three-letter abbreviation for the name of our nation—*USA*. Other large reservoirs are backed up by big dams owned by the federal government (such as Canyon Ferry), the State of Montana (such as Tongue and Painted Rocks), or private utilities (such as Noxon Rapids).

## GROUNDWATER

Groundwater comes from rain and snowmelt that seep into the ground and fill spaces between certain types of rocks and dirt over thousands of years. We call these water-bearing geologic formations "aquifers." To tap groundwater, usually a well or large pipe must be drilled into a water-bearing formation, and the water must be pumped to the surface. Aquifers that release water to the surface are called "springs" or "artesian wells." Eighty-seven percent of the community water supply systems rely on groundwater, and 35 percent of our population depends on groundwater for drinking. Little is known about Montana's groundwater because you cannot see it and it is difficult and expensive to study.

## WATER QUALITY

Montana's waters are generally very clean, but water quality problems do exist. One of the largest water quality problems is arsenic in the Madison and Missouri rivers. It originates from natural geothermal activity within Yellowstone National Park. The arsenic concentrations far exceed the cancer risk established by the Environmental Protection Agency (EPA). The upper Clark Fork River has four "Superfund" sites that were

designated by EPA because of all the heavy metal mine waste that was allowed to enter the river in the 1800s and early 1900s. It is now costing millions of dollars to clean up the problem. The American Rivers Association has named the Blackfoot River one of the 10 most threatened rivers in the nation. Robert Redford has made the Blackfoot famous by making a movie about it called *A River Runs Through It*. Other activities such as agriculture and timber harvesting increase nitrates, phosphates, sedimentation, and water temperatures; they may also dewater streams and lower the levels of dissolved oxygen. Such pollution can cause our rivers and lakes to turn green and kill fish and other aquatic life. It can also make expensive water treatment necessary before the water is fit for other uses, like drinking.

## THE IMPORTANCE OF WATER IN MONTANA

Can you imagine what life was like in Montana one hundred years ago? Water was critical for just about everything in Montana's past, and just about every image we can conjure up about Montana's history probably relates back to water. Think about a topic in Montana's history. Can you relate it to water? Here's some food for thought.

### EARLY MONTANA INDIANS

The Crow, Sioux, Chippewa-Cree, Gros Ventre, Assiniboine, Cheyenne, Salish, Kootenai, Blackfeet, and Blood Indians lived in Montana and needed water for life. It quenched their thirst and that of the wild animals, such as buffalo and elk, that they used for food, clothing, and shelter. Water was a central feature of their culture and religious beliefs. They traveled on waterways in canoes and "bull boats"—the latter were used by the Sioux. Water also fell as snow, making survival in harsh winters a difficult challenge.

### EXPLORERS

Meriwether Lewis and William Clark are famous for their travel up the Missouri, "the first Montana high-

way." As agents for President Thomas Jefferson, they were commissioned to explore the Pacific Northwest in 1805. They journeyed over 1,000 miles on Montana watercourses, naming a number of them. The Milk River was christened for its milky appearance; the Marias was named after the wife of a friend; still others, like the Madison, Gallatin, and Jefferson, were named after recognized political figures prominent during that time. Did you know that Captain William Clark named two rivers after himself—one the Clark Fork of the Columbia River and the other the Clarks Fork of the Yellowstone River? Going west through the unexplored territory of Montana, Lewis and Clark pulled and poled their way against strong currents of the Missouri, Jefferson, and Beaverhead rivers. They almost went up the Marias by mistake, thinking that it was the Missouri. On the return trip, Lewis went up the Clark Fork River, crossed the Continental Divide, and floated down the Missouri, while Clark explored southern Montana and traveled down the Yellowstone River. They met where the two rivers join just after they leave Montana.

### FUR TRAPPERS AND TRADERS

The era of the fur trappers and traders was ushered into western Montana by Lewis and Clark's glowing descriptions. The first fur trader was a Louisiana Spaniard, Manuel Lisa, who led a sizeable expedition up the Missouri River to the Yellowstone River. At the confluence of the Yellowstone and Bighorn rivers, the group built the first permanent structure erected by white men—Fort Remon or "Lisa's Fort"—in November 1807. But Indian resentment of such intrusions led to violent raids and death, which turned back efforts to establish permanent footholds along many Montana watercourses for decades. Two rival groups competed for dominance in the fur trade in early Montana—Canadians and Americans. The Continental Divide separated their territories. The Canadians trapped fur-bearing animals in the upper Columbia River basin near the Clark Fork and Kootenai rivers, while the Americans claimed the territory east of the divide on the tributaries of the Missouri River.

## MINERS

The first mining of quartz, gold, and silver ore took place at the Dakota Lode near Bannock in 1863. Machinery and construction materials necessary for mining had to be brought in by freight. Transportation of these materials to the mines was a serious problem. The first paddlewheel steamboats reached Fort Benton (traveling from St. Louis, Missouri) in 1860. Thus, Montana's rivers established an important lifeline into the frontier. However, the deadly disease, smallpox, which was brought up the Missouri on a paddlewheel steamboat, considerably weakened the Blackfeet and other tribes, making it easier for the white man to settle Montana. Because of the waterfalls on the Missouri near the present city of Great Falls, Fort Benton was the farthest the steamboats could reach. Supplies for miners then had to be shipped overland—for more than 300 miles. But demands were such that what began as a trickle of steamboat traffic on the Missouri at Fort Benton turned into a flood. Traffic peaked in 1867 when thirty-nine boats tied there, leaving passengers, mining equipment, and supplies; gold bullion, hides, and wool were then loaded for the return trip to St. Louis.

Water was essential for successful gold mining in Montana, from the most simple technique—placer mining—to the more advanced methods of hydraulic ore extraction. Placer miners dug up gold-bearing dirt with picks and shovels and used water to flush away waste material. In “hydraulicking,” another means of getting at precious ore, high pressure hoses were used to blast away entire stream banks.

These miners, many from the gold fields of California, brought with them the “Prior Appropriation Doctrine” for regulating water use. That is, the first person to divert, develop, and use the water had the first right to it, followed by the second person to divert, develop, and use the water, and so on. During times of drought, when water was in short supply, only those with the earliest “priority date” (or date of first use) had enough water to satisfy their needs. Those with later water rights went without. That system of water rights is still in effect in Montana today.

## FARMERS AND RANCHERS

The first white farmers in Montana were also fur traders and missionaries. Through the use of irrigation, they successfully raised impressive crops and grazed livestock at fur posts such as Fort Connah. Although some dams were constructed to irrigate more land, few homesteaders were lucky enough to live by streams. Thus, for many early Montanans, carrying water in buckets and barrels from water sources miles away was a daily chore. Some also tried to rely on “buffalo wallows” to catch rain water, or they made “cisterns” to collect what they could nearby. But drinking water from such sources sometimes led to entire families coming down with “prairie fever” (typhoid).

Cattlemen actually entered the Montana area before the gold rush, but the real boom of the region's stock industry occurred in the 1880s. By 1886, the ranges were overstocked. The situation became dangerous when cold, wind, and snow ushered in temperatures as low as -67 degrees. The overgrazed lands provided scant forage, and that fact, combined with the extreme weather, led to stock losses estimated at 362,000 cattle, or 60 percent of the Montana territory's entire beef population. The painful lesson had an important outcome: ranchers realized that it was essential to have feed available to carry their herds through Montana's long winters. The only way to ensure this was to irrigate a portion of their lands and produce their winter feed themselves. Thus did irrigated agriculture attain importance in Montana. Today, Montanans irrigate more than 2.6 million acres, ranking our state seventh in the nation in the number of acres irrigated.

Although others may have staked claims to water for mining many years earlier, the first official water right “decreed” for irrigation was for water diverted from Burnt Fork Creek on July 1, 1852, for use upon land surrounding historic Fort Owen (in Ravalli County near Stevensville).

The prolonged lack of rain or “drought” of the 1920s, 1930s, and 1940s taught us some hard lessons and forced many homesteaders off their land. They learned that

they could not depend on the rains, but had to take stream or stored water to the lands. The droughts convinced the U.S. Congress and the Montana Legislature to fund the construction of large water projects. They felt that Montana needed to develop irrigation and water storage reservoirs to ensure stable water supplies and, thus, the settlement of our "semi-arid" lands.

## FISH AND WILDLIFE

Today, it is difficult for us to visualize how abundant wildlife were in early Montana. Lewis and Clark's journals are full of powerful descriptions of the game that sustained them as they journeyed down the Missouri.

*We saw vast quantities of buffalo, elk, deer, principally of the long tailed kind, antelopes, beaver, geese, ducks, brant and some swan. The porcupines too are numerous, and so careless and clumsy that we can approach very near without disturbing them.*

and,

*The game is now in great quantities, particularly the elk and buffalo, which last is so gentle that the men are obliged to drive them out of the way with sticks and stones. The ravages of the beaver are very apparent: in one place the timber was entirely prostrated for a space of three acres in front on the river...*

Native fish like the cutthroat, bull trout, and arctic grayling were also abundant. However, the development of irrigation and other "consumptive" uses of water depleted many of our rivers and streams. It wasn't until the early 1970s that we began to understand that water left instream was valuable for the protection of fish, wildlife, recreation, and water quality and for the production of hydroelectricity. Laws passed during this time allowed us to begin to protect these instream values.

## HYDROPOWER

Water power was first developed at Black Eagle Falls in 1890 for the copper smelter at Great Falls. Soon after, a number of small hydropower facilities were built to

produce electricity for processing ore in Butte and Anaconda. Miners realized that steam power cost about twice as much as hydropower, starting a boom in the development of hydroelectricity. The need for cheap power increased with the construction of a transcontinental railway across Montana that operated on electricity. Today, Montanans pay one of the nation's lower rates for electricity because of the many hydropower facilities built in the state. Hydropower uses over 74 million acre-feet each year. This water is not consumed, but passes through turbines and then goes on downstream.

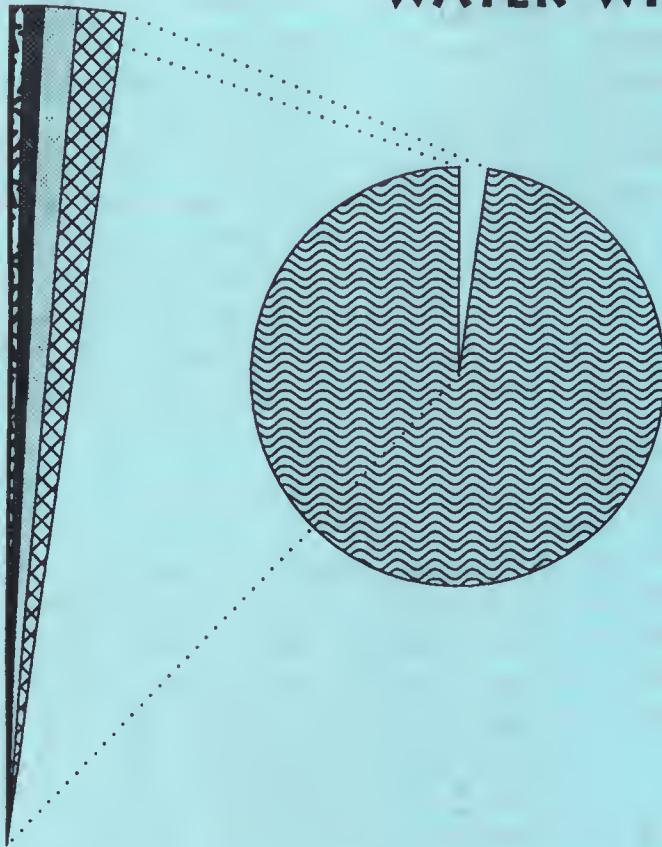
## TODAY'S WATER USES







Water is still critically important to Montana's economy. Irrigation water produces alfalfa and hay for feeding cattle and other livestock, and it also grows important crops like corn and potatoes. Montana is becoming a haven for recreation, in part because of the quality of the streams, rivers, and lakes. It is easy to take water for granted. Every day, we all use it to drink, to wash our dishes and clothes, to take baths, and to water our gardens and lawn. We use it to generate electricity for heating some homes; operating televisions, radios and stoves; and reading after dark.

The following page contains pie charts showing the percentages of water diverted and consumed for the major uses in Montana. Agriculture, the largest consumer, uses 97.6 percent of the water withdrawn or diverted each year. All the other users combined use 2.4 percent.

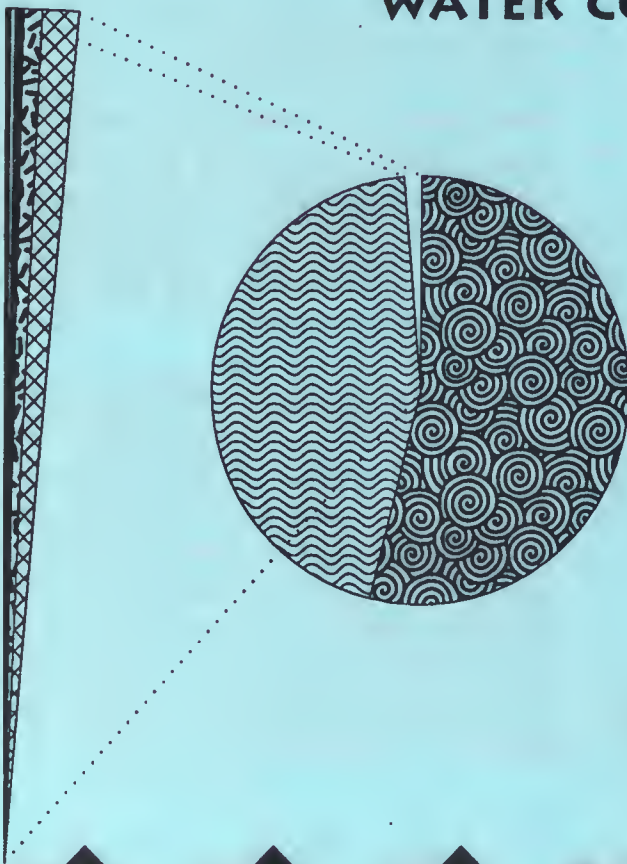
We must be careful with our water, for there is only so much. We must not use it all up for consumptive purposes, and we must not destroy its quality for drinking, recreation, wildlife and fish. But we must share it. Agriculture and other consumptive uses are an important part of our heritage and must be preserved, for the sake of our present and future economy. All water users, including you, must use it wisely and carefully so that there is enough to go around to benefit all Montanans—today and into the future.








# WATER WITHDRAWALS



	1,000 acre-feet	Percent
 Irrigation	15,044	97.6
 Municipal	157	1.0
 Thermolectric power generation	107	0.7
 Self-supplied industry	62	0.4
 Livestock	28	0.2
 Rural domestic	16	0.1
	15,414	100.0

# WATER CONSUMPTION



	1,000 acre-feet	Percent
 Reservoir evaporation	3,925	53.8
 Irrigation	3,251	44.6
 Municipal	58	0.8
 Livestock	28	0.4
 Rural domestic	16	0.2
 Thermolectric power generation	9	0.1
 Self-supplied industry	9	0.1
	7,296	100.0

# QUESTIONS YOU MAY WISH TO ASK YOUR STUDENTS ABOUT WATER.

## CAN YOU IDENTIFY THE FEATURES ON THE ENCLOSED MAP OF MONTANA?

1. What is the largest freshwater lake west of the Mississippi River? *Answer:* Flathead Lake.
2. What are the four "Wild and Scenic River" stretches in Montana? *Answer:* North Fork, South Fork, and Middle Fork of the Flathead River and a stretch of the Missouri River downstream of Fort Benton.
3. What is the one place in North America where falling water eventually flows into three oceans? *Answer:* Triple Divide Peak in Glacier National Park.
4. What is the largest reservoir in Montana? *Answer:* Fort Peck Reservoir.
5. What part of Montana receives the largest amount of precipitation in rainfall and snow each year? *Answer:* The high mountain areas in western Montana (Glacier National Park).
6. Which river originates in Montana, enters Canada, and then returns to Montana? *Answer:* The Milk River. Trace the river on your map.
7. What is a major water quality problem in the Missouri River basin, and where does it come from? *Answer:* Arsenic originating from natural geothermal activity within Yellowstone National Park.
8. What large reservoir in the Yellowstone River basin crosses into Wyoming? *Answer:* Yellowtail Reservoir on the Bighorn River.
9. Which of the following is the largest river in Montana: the Kootenai, Clark Fork, Missouri, or Yellowstone river? *Answer:* The Clark Fork.
10. Which river was often called the "Elk River" by American Indians? *Answer:* The Yellowstone River.
11. What is one of the Montana locations that receive the least amount of precipitation each year? *Answer:* Belfry, Montana, in the Clarks Fork drainage, the Helena Valley, the Whitehall-Twin Bridges Valley, or the lower Red Rock River drainage.
12. Which river is home to most of the last stream-dwelling native arctic grayling in the lower 48 states? *Answer:* The Big Hole River.
13. Which lake was created when a catastrophic earthquake dammed the Madison River? *Answer:* Quake Lake.
14. Which Montana reservoir has a shoreline longer than the coastline of California? *Answer:* Fort Peck Reservoir.
15. Thousands of years ago, large glaciers pushed the Missouri River south. Which river now occupies portions of the ancient Missouri River channel and valley? *Answer:* The Milk River.
16. What is the only river in Montana that flows both directly north and directly south? *Answer:* The Big Hole River.
17. What river is the longest free-flowing river in the lower 48 states? *Answer:* The Yellowstone River.
18. Which river, affected by past mining, now has four EPA "Superfund" sites? *Answer:* The upper Clark Fork above Milltown.

19. Which reservoir is named after the Kootenai River, Canada, and the United States? *Answer:* Lake Koocanusa.
20. What are two large reservoirs in the headwaters of the Columbia River drainage? *Answer:* Hungry Horse Reservoir and Lake Koocanusa.
21. Which Montana river was recently named as one of the 10 most threatened in the United States? *Answer:* The Blackfoot River.
22. What is the name of the science that studies water? *Answer:* Hydrology.
23. Who owns the big dams in Montana? *Answer:* The federal government, state government, and private utilities.
24. Where do most of the farmers and ranchers get their drinking water? *Answer:* Groundwater.
25. What do you call a water-bearing geologic formation? *Answer:* An aquifer.
26. Which river is the subject of the Robert Redford film called *A River Runs Through It*? *Answer:* The Blackfoot River.
27. Which rivers did Lewis and Clark follow as they crossed Montana going to the Pacific Ocean? Which rivers did they use to return to St. Louis, Missouri? *Answer:* Missouri, Jefferson, and Beaverhead rivers when going west, and Yellowstone, Clark Fork, and Missouri rivers when returning east. Trace these rivers on your map.
28. What three tributaries forming the Missouri River did Lewis and Clark name for political figures? *Answer:* The Gallatin, the Madison, and the Jefferson rivers.
29. How far up the Missouri River did the paddlewheel boats travel, and what stopped them? *Answer:* They traveled from St. Louis, Missouri, to Fort Benton and were stopped by the waterfalls near Great Falls, Montana.
30. On their journey to the Pacific Ocean, which river did Lewis and Clark almost mistake for the Missouri River? *Answer:* The Marias River.
31. What were some major uses of water by the early Indians? *Answer:* Transportation, cultural, and religious purposes.
32. What river was "Montana's first highway"? *Answer:* The Missouri River.
33. Why was water important to mining? *Answer:* It was used to wash the dirt away from the ore.
34. Who were the first groups to irrigate in Montana? *Answer:* Fur traders and missionaries.
35. What early fort in central Montana was a well-known port for steamboats? *Answer:* Fort Benton.
36. For what use was the first official water right decreed? *Answer:* Irrigation.
37. What location was the site of the first decreed water right? *Answer:* Fort Owen near Stevensville.
38. What are some important uses of water left in the stream? *Answer:* The protection of fish, wildlife, and water quality; recreation; and the production of hydroelectricity.
39. What industries boosted the development of hydroelectricity in Montana? *Answer:* Mining and transportation.
40. What is the largest use of diverted water in Montana? *Answer:* Most of the diverted water (97.6 percent) is used for irrigation.



# "QUICK RECOVERY" ACTIVITY FOR STUDENTS

## PREPARATION

You'll need 40 or more index cards.

On each card write a short paragraph about Montana's water history and facts.

Select questions from the attached sheet that directly relate to the fact cards.

Highlight these.

Pass the cards out to the students.

Give each student a map of Montana.

## PROCEDURE

1. Ask students to read their card(s) and listen to see if the information they read answers the questions you've selected.

2. Read the first question. The student with the correct response should raise his or her hand and read the card.

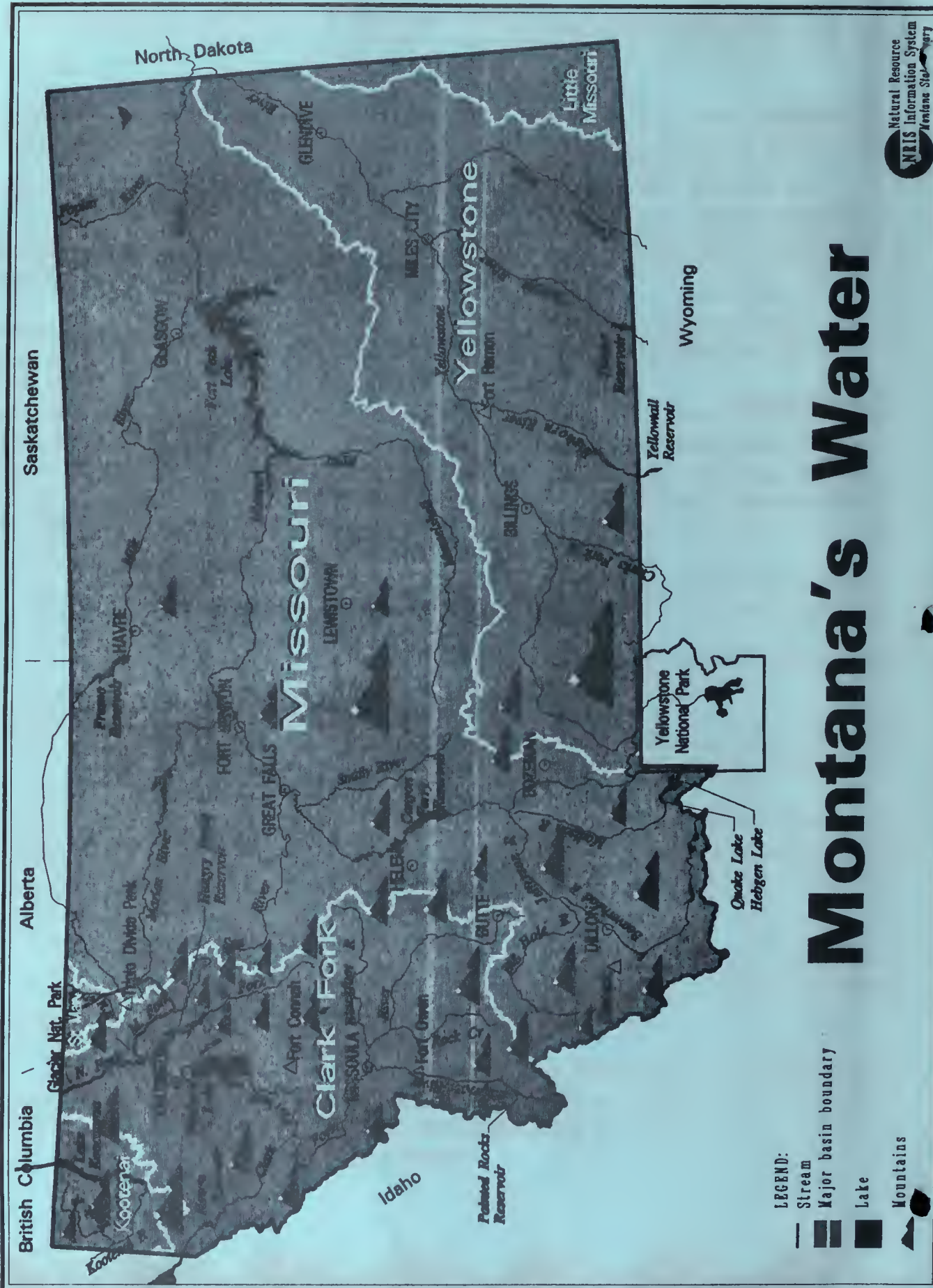
3. Once a student answers a question, he or she can read the next question.

4. If the question relates to a place in Montana, you can point out the locations to the students on their maps.

5. Once the class has heard all the questions and answers, you can divide the students into teams of two or more. Read the questions and time the response from each team; the team with the quickest answer time wins. Next, take all the cards away and allow either team to answer any question. Again, the team with the fastest time wins. You can also do races to the map in connection with questions that deal with locations in Montana.

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# Montana's Water

- LEGEND:**
- Stream
  - ▭ Major basin boundary
  - ◻ Lake
  - ▲ Mountains

